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【INVENTOR】

【DOMICILE OR RESIDENCE】 c/o KANEBO CHEMICAL INDUSTRIES, LTD, 2-2 UMEDA 1-CHOUME, KITA-KU OSAKA-SHI, OSAKA

【NAME】 MASAHIRO SHODA

【INVENTOR】

【DOMICILE OR RESIDENCE】 c/o KANEBO CHEMICAL INDUSTRIES, LTD, 2-2 UMEDA 1-CHOUME, KITA-KU OSAKA-SHI, OSAKA

【NAME】 YOSHIKAZU KIMURA

【APPLICANT OF PATENT APPLICATION】

【IDENTIFICATION NUMBER】 000000952

【NAME】 KANEBO, LIMITED

【REPRESENTATIVE】 TAKASHI HOASHI

【PHONE NUMBER】 03-5446-3575

【APPLICANT OF PATENT APPLICATION】

【IDENTIFICATION NUMBER】 000104294

【NAME】 KANEBO CHEMICAL INDUSTRIES, LTD

【GOVERNMENT FEE】

【LEDGER NUMBER】 010205

【FEE】 ¥21,000

【LIST OF ATTACHED ITEMS】

【ITEM】 CLAIM 1

【ITEM】 SPECIFICATION 1

【ITEM】 ABSTRACT 1

【DOCUMENT NAME】 CLAIM

【CLAIM 1】

Artificial hair composed of monofilaments containing poly(trimethylene terephthalate).

【CLAIM 2】

Artificial hair set forth in claim 1, being monofilaments having a denier of 22 to 333 decitex, a melting point of 225 to 235°C, and a glass transition temperature of 45 to 80°C.

【DOCUMENT NAME】 SPECIFICATION

【TITLE OF THE INVENTION】 ARTIFICIAL HAIR

【TECHNICAL FIELD】

【0001】

The present invention relates to artificial hair whose look and feel both are close in character to that of natural human hair, and which holds that character with the passage of time.

【PRIOR ART】

【0002】

Synthetic fiber materials such as polyester, acrylic, vinyl chloride, and nylon have traditionally been employed for artificial hair used in wigs, toupees, and the like. For example, by mixing together polyethylene terephthalate and polybutylene terephthalate, an attempt has been made to improve the texture (PATENT DOCUMENT 1). In another example, toward improving the texture of artificial hair and ease of handling when braiding or doing similar handiwork, polyethylene terephthalate has been spun into flat, even fibers and yarns for artificial hair (PATENT DOCUMENT 2).

【0003】

【PATENT DOCUMENT 1】 Japanese Unexamined Pat. App. Pub. No. H12-356799

【PATENT DOCUMENT 2】 Japanese Unexamined Pat. App.

Pub. No. H09-132813

【DISCLOSURE OF INVENTION】

【PROBLEM TO BE RESOLVED BY THE INVENTION】

【0004】

When wigs employing artificial hair materials such as noted above are worn and the wearer goes about his or her daily routine, as hair the material takes on an unnatural frizziness and gloss peculiar to synthetic fibers. What happens as a result is that the natural feeling of the artificial hair as a replacement, given forth by its texture, elastic recovery and other properties, is spoiled, compromising its value as a wig.

【MEANS TO SOLVE THE PROBLEMS】

【0005】

The present inventors overcame the problems discussed above by using poly(trimethylene terephthalate) in monofilaments.

【0006】

Namely, by means of:

(1)Artificial hair of present invention composed of monofilaments containing poly(trimethylene terephthalate); or

(2)Artificial hair set forth in (1), being monofilaments having a denier of 22 to 333 decitex,

a melting point of 225 to 235°C, and a glass transition temperature of 45 to 80°C;

artificial hair of the present invention in terms of its physical properties of elastic recovery, strength, stretch, and texture resembles natural human hair, and the occurrence of frizzes and gloss is kept under control.

【0007】

Poly(trimethylene terephthalate) included in the present invention may be poly(trimethylene terephthalate) alone, or may be the copolymers of poly(trimethylene terephthalate) set forth below. Namely, as to the substances for copolymerization with poly(trimethylene terephthalate), an acid component—such as isophthalic acid, succinic acid, adipic acid, or 2,6-naphthalene dicarboxylic acid—a glycol component—such as 1,4-butanediol, 1,6-hexanediol, or cylcohexanedimethanol—or ε-caprolactam, 4-hydroxybenzoic acid, polyoxyethylene glycol, polytetramethylene glycol, etc. may be copolymerized as long as they do not compromise the effectiveness of the present invention, and may be copolymerized in an amount less than 10 wt.%.

【0008】

In addition, the poly(trimethylene terephthalate) or

copolymer thereof may be, according to requirements, copolymerized or mixed with various additives, such as deglossers, heat stabilizers, defoamers, toners, flame retardants, antioxidants, ultraviolet absorbers, infrared absorbers, crystallizers, and fluorescent brighteners, for example.

【0009】

The polymer constituting poly(trimethylene terephthalate)-containing monofilaments in artificial hair of the present invention can be polymerized using a publicly known method. For example, the polymer can be produced by transesterifying terephthalic acid, or an ester of terephthalic acid and a primary alcohol, with an abundance of 1,3-propanediol in the presence of tetrabutyl titanate or a similar catalyst, and subsequently adding tetrabutyl titanate or a like catalyst to the obtained reactant and subjecting the combination to a polycondensation reaction at 240 to 280°C under a vacuum of 0.5 torr or lower. Monofilaments can then be manufactured from the obtained polymer by a routine spinning method.

【0010】

The molecular weight of the polymer constituting poly(trimethylene terephthalate)-containing monofilaments in artificial hair of the present

invention is defined according to intrinsic viscosity measured by the method set forth under Embodiments. The intrinsic viscosity [$\eta$] is ordinarily 0.4 to 2.0, preferably 0.5 to 1.5, more preferably 0.6 to 1.2. When the intrinsic viscosity is 0.4 or more, the spinability of the polymer stabilizes owing to its high melt viscosity. Strength of the obtained fiber is high and satisfactory. Conversely, when the intrinsic viscosity is 2.0 or less, because the melt viscosity is not overly high, metering with the gear pump goes smoothly, such that there is no detriment to the spinability due to improper discharge or other polymer flow problems.

【0011】

Poly(trimethylene terephthalate)-containing monofilaments in artificial hair of the present invention preferably have a monofilament denier of 22 to 333 decitex (dtex). Furthermore, a denier of 40 to 250 dtex, or further still, of 50 to 200 dtex, makes it possible to gain texture, an appearance and touch close to that of natural human hair.

【0012】

Poly(trimethylene terephthalate)-containing monofilaments in artificial hair of the present invention ideally have a glass transition temperature (shortened to *Tg* hereinafter) of 45 to 80°C. Since the

*Tg* corresponds to the molecular density of the filament amorphous portion, the smaller this value is, the smaller will be the molecular density of the amorphous portion, owing to which the molecules will function more readily. As long as the *Tg* does not exceed 80°C, the fibers will not become overly stiff, allowing the fibers to be set as hair. As long as the *Tg* is more than 45°C, the texture of the fibers as hair will not be spoiled. From the perspective of good balance to the fibers as hair, the *Tg* is preferably 45 to 70°C, more preferably 55 to 65°C.

【0013】

Inasmuch as the *Tg* is thus a structural factor in a fiber, polymers possessing the same molecular structure will nonetheless exhibit different *Tg* values depending on the spinning conditions, including spinning temperature, spinning speed, draw ratio, heater treatment temperature and the like.

【0014】

The cross-sectional form of poly(trimethylene terephthalate)-containing monofilaments in artificial hair of the present invention is not particularly limited and may be, to give examples, round, triangular, square or pentagonal; or the filaments may be flat.

【0015】

Poly(trimethylene terephthalate)-containing

monofilaments in artificial hair of the present invention are manufacturable by publicly known methods. Namely, the monofilaments are manufacturable for example by a method in which polymer extruded through a nozzle, cold-hardened using cooling water, and then wrapped several times onto a roll spun at uniform speed, whereupon drawing is carried out between a first roll and a second roll installed succeeding the first roll so that absolutely no tension is transmitted before and after the roll, and thereafter the drawn filament is spooled with a winder.

【0016】

The spinning temperature when melt-spinning the polymer of the monofilaments is suitably 240 to 320°C, preferably 245 to 300°C, more preferably 250 to 280°C. Stabilized fluidity is obtained with a spinning temperature of 240°C or more, the spinability is not compromised, and a satisfying strength is demonstrated. With a spinning temperature of no greater than 320°C, thermal decomposition is not severe, there is no coloring of the obtained filament, and a satisfying strength is demonstrated.

【0017】

As to the speed at which the filament is spooled, while there is no particular limitation, ordinarily it is

spooled at 1500 m/min or less, preferably 500 m/min or less, more preferably 400 m/min or less. Cooling is facilitated when the spooling speed is no greater than 1500 m/min. A satisfactory draw ratio for the drawing operation is 2.0 to 4.0 times, preferably 2.2 to 3.7 times, more preferably 2.5 to 3.5 times. With a draw ratio of 2.0 times or greater, the polymer can adequately be oriented by the drawing operation, such that the strength of the obtained filament is unlikely to prove to be low. Likewise, with a draw ratio of no greater than 4.0 times, the filament is kept from breaking, which enables a stable drawing operation to be carried out.

【0018】

A satisfactory temperature when drawing is 35 to 100°C in the draw zone, preferably 40 to 100°C, more preferably 50 to 100°C. With a draw-zone temperature of 35°C or more, filament breakage when drawing diminish, such that a continuous monofilament can be produced. Likewise, as long as the temperature is no greater than 100°C, the smoothness of the draw rolls etc. for the fiber with respect to the heating zone will not deteriorate, such that filament breakage diminish. Furthermore, the obtained filament may according to requirements be put through a 120 to 180°C thermosetting process.

【EFFECTS OF THE INVENTION】

【0019】

When utilized in artificial hair, poly(trimethylene terephthalate)-containing monofilaments of the present invention, compared with artificial hair composed of polyamide fibers, polyester fibers, acrylic fibers, or similar publicly known fibers, markedly improve the look, feel, and similar characteristics. Accordingly, artificial hair composed of poly(trimethylene terephthalate)-containing monofilaments of the present invention is extremely serviceable.

【Best Mode for Carrying Out the Invention】

【0020】

While embodiments will be given below to describe the present invention more specifically, inasmuch as the embodiments are only exemplary, the present invention is of course not thereby limited. It is also to be noted that the principal measurements in the embodiments were determined by the following methods.

【0021】

(1)Intrinsic Viscosity

Determined by a measurement technique using an Ostwald viscometer on polymer at 1% concentration and 35°C in ortho-chlorophenol as a solvent.

【0022】

(2)Glass Transition Temperature

Measured within dry nitrogen at a ramp-up speed of 20°C/min, utilizing the Exstar-6000, a differential scanning calorimeter manufactured by Seiko Instruments, Inc.

【0023】

(3)Elastic Recovery

A 200-gram weight was hung on a 100-centimeter-length sample for 24 hours, following which the sample was freed and after 1 hour its length measured.

【0024】

(4)Texture Comparison

The texture of the artificial hair was compared visually with that of natural human hair.

◎: Texture extraordinarily close to that of natural human hair

○: Texture close to that of natural human hair

△: Could tell that it is not natural human hair

×: Could clearly tell that it is not natural human hair

【EMBODIMENTS】

【0025】

(Embodiments 1 through 3)

Melt extrusion employing poly(trimethylene terephthalate) was carried out at a 270°C spinning temperature, and filaments were spun at a draw ratio of

2.5 times. Monofilaments having deniers of 55, 111 and 222 dtex were spun. The results of the evaluations done on the obtained monofilaments are set forth in Table One. The obtained monofilaments had a *Tg* of 55°C, in elastic recovery, yielded results near to 100%, and in the comparison with natural human hair, yielded a texture very close to that of natural human hair.

【0026】

【Table One】

| | Raw thread material | Denier (D) | *Tg* (°C) | Elastic recovery (%) | Comparison with natural human hair |
|---|---|---|---|---|---|
| Embod. 1 | PTT | 50 | 55 | 100 | ◎ |
| Embod. 2 | PTT | 100 | 55 | 100 | ◎ |
| Embod. 3 | PTT | 200 | 55 | 99 | ◎ |
| Embod. 4 | PTT | 50 | 65 | 100 | ◎ |
| Embod. 5 | PTT | 100 | 65 | 100 | ◎ |
| Embod. 6 | PTT | 200 | 65 | 99 | ◎ |

PTT: poly(trimethylene terephthalate)

【0027】

(Embodiments 4 through 6)

Melt extrusion employing poly(trimethylene terephthalate) was carried out at a 270°C spinning temperature, and filaments were spun at a draw ratio of 3.5 times. Monofilaments having deniers of 55, 111 and 222 dtex were spun. The results of the evaluations done on the obtained monofilaments are set forth in Table One. The obtained monofilaments had a *Tg* of 65°C, in elastic recovery, yielded results near 100%, and in the comparison with natural human hair, yielded a texture very close to that of natural human hair.

【0028】

(Comparative Examples 1 through 8)

Polyethylene terephthalate (PET), nylon (Ny), acrylic (AN), and polyvinyl chloride (PVC) were spun into filaments, that were evaluated in the same way. The results are set forth in Table Two. In these cases, in whichever denier, a texture near that of natural human hair could not be obtained.

【0029】

【Table Two】

| | Raw thread material | Denier (D) | *Tg* (°C) | Elastic recovery (%) | Comparison with natural human hair |
|---|---|---|---|---|---|
| Comp. Ex. 1 | PET | 50 | 68 | 95 | △ |
| Comp. Ex. 2 | PET | 100 | 68 | 95 | △ |
| Comp. Ex. 3 | Ny | 50 | 47 | 90 | △ |
| Comp. Ex. 4 | Ny | 100 | 47 | 90 | △ |
| Comp. Ex. 5 | AN | 50 | unclear | 85 | △ |
| Comp. Ex. 6 | AN | 100 | unclear | 85 | △ |
| Comp. Ex. 7 | PVC | 50 | 82 | 80 | × |
| Comp. Ex. 8 | PVC | 100 | 82 | 80 | × |

PET: Polyethylene terephthalate

Ny : nylon

AN : acrylic

PVC: polyvinyl chloride

【DOCUMENT NAME】 ABSTRACT

【ABSTRACT】

【PROBLEM TO BE SOLVED】 The prevent invention relates to a artificial hair having a look and feel that both are close in character to that of natural human hair, compared with artificial hair made from polyamide fibers, polyester fibers, acrylic fibers, etc., and which holds that character over time.

【SOLUTION】 By means of artificial hair composed of monofilaments containing poly(trimethylene terephthalate), or by means of artificial hair composed of monofilaments containing poly(trimethylene terephthalate) having a denier of 22 to 333 dtex, a melting point of 225 to 235°C, a glass transition temperature of 45 to 80°C, the physical properties of elastic recovery, strength, stretch, and texture resemble natural human hair, and the occurrence of frizzes and gloss is kept under control.

【ELECTED VIEW】 None